Oshima puts composites at the heart of cargo carrier concept

Japanese shipbuilder says the laminate lay-up tween decks offer improved capacity utilisation and optimised loading

First established in the 1970s, Japan's Oshima Shipbuilding quickly developed a specialism as one of the leading suppliers of handysize, handymax and panamax bulk carriers. However, the prolonged downturn in the dry sector is leading shipowners to seek more economical, innovative and versatile solutions. With this in mind, Oshima has teamed up with classification society DNV GL, a frequent partner, on a joint development project (JDP) for a new 65,000dwt open-hatch general cargo carrier concept.

Flexibility is a critical requirement of the open-hatch carrier segment and there is a growing tendency for vessels to carry various different cargoes during a single voyage. In the early stages of the JDP, Oshima interviewed some of the leading players in this market to gain insight on the owners' particular demands for cargo carrying and loading capabilities, as well as their fleet profiles and typical trading patterns.

Oshima and DNV GL state that the 210m length design, which was formally unveiled at last year's Nor-Shipping event in Oslo, is characterised by a large cubic (77,000m^3) and deadweight capacity (65,000 tonnes) but with a comparatively shallow draught (13.1m) thanks to its wider breadth. It is equipped with eight box-shaped cargo holds with full-width hatch openings of both the 'piggyback' (six holds) and folding types (two holds).

Its design has been further optimised for project cargoes with the inclusion of two longer cargo holds. Four of the vessel's holds can be fitted with tween decks to allow for segregating different cargoes. Because of the vessel's wide breadth and the hull's double sides and bottom it would not need to use the holds to carry water in heavy ballast conditions.

The new vessel concept draws heavily from the Oshima ECO-Ship 2020, a 2011JDP between Oshima and DNV (prior to its merger with GL), and utilises a number of established technologies. However, while the vessel is a ready-to-

Oshima's new open-hatch cargo carrier concept was unveiled at Nor-Shipping last year

order design, shipowners will also have the option of installing a number of new innovations rarely seen on dry cargo vessels, such as battery-assisted hybridised cranes and an optimised main engine with a PTO/PTI (power take out/power take in) shaft generator.

Composite hatches and tween decks

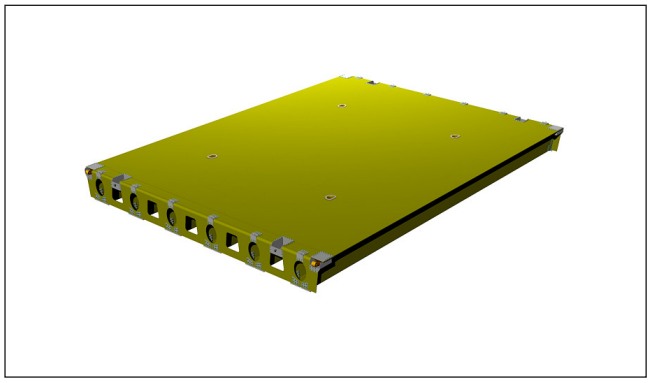
Perhaps most notable though is the use of composite materials; whereas the ECO-Ship 2020 included composite hatch covers, the new design extends their use to the tween decks. Oshima tells *The Naval Architect* that while the composite used – laminate lay-up – uses similar raw materials to those found in the hatch covers of the ECO-Ship 2020 (and a very similar 2013 design for a Panamax bulker received DNV GL's AiP and Panama flag approval in 2013), and load-bearing components, the laminate thicknesses and the solutions for some of the details are very different.

Made from glass-fibre-reinforced plastic (GFRP), prototypes of the tween decks solution were developed in partnership with Japan's I-Know Machinery and Norway-headquartered solutions provider CompOcean, with manufacturing taking place at CompOcean's Latvian plant. However, if and when the open-hatch general cargo carrier concept enters production this task will need to be undertaken at a specialist workshop in Asia, within easy access of the shipyard or near a port where the ship can berth to pick up and install the tween decks.

Responding jointly to *The Naval Architect*, Oshima and DNV GL explain that from a shipbuilding perspective the use of composites is really no different from that of any other material used in ship construction: "Manufacturing outside the shipyard is not a particular challenge, given that most components in shipbuilding are manufactured outside the shipyard. There are also plenty of composites manufacturers in the world. The tween decks are designed to be installed (and moved/mobilized) by the ship's own cranes. When not in use the tween decks are stored on container sockets or on dedicated support point. When mobilized for use, the tween decks are supported by dedicated support brackets in the cargo holds."

They add that aside from the material engineering there are essentially no additional considerations: "Composite material engineering allows for designing and optimising the material easily, for instance a given structure in function of a load case. Raw materials (fibre, resin), laminate design, failure modes, composite material final properties as produced by manufacturer, quality assurance and quality control of the fabrication process are important features of composite material engineering, and hence also important aspects reviewed under an approval."

The tween deck solution for one short



The composite tween deck panel

cargo hold comprises of two identical panels; each is constructed of a single skin, with the top plate adhesively bonded to the corrugations which are in turn bonded to end plates. Retractable brackets welded to the hold's transverse bulkheads support the panel ends.

Raw materials for composites (glass fibre and resin) are typically more expensive per kilogram compared to steel. However, Oshima says that the production process (for its structural design) is also much more efficient compared to steel tween decks.

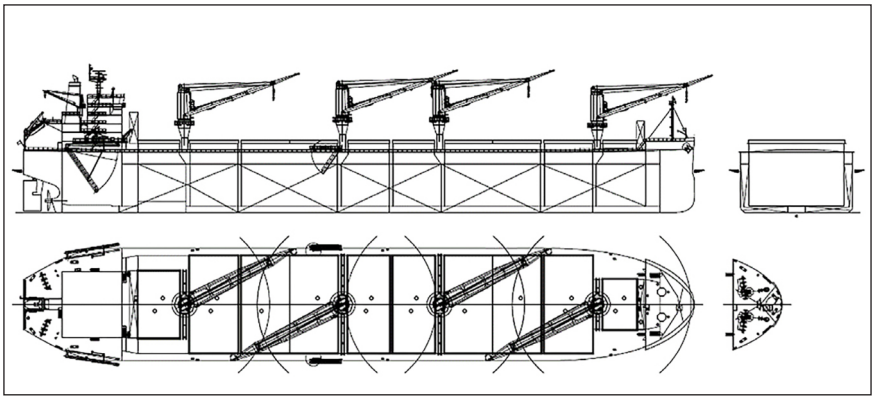
Oshima adds that the final tween deck is comparable in cost with its steel equivalent due to a significant weight reduction compared to its steel equivalent (around 40-50%). Moreover, because conventional steel tween decks are smaller more are needed than the composite solution, which also cuts down on installation time when in port.

Oshima estimates that fuel savings of 0.25% are achievable with four composite tween decks, but adds: "For the owner, the possibility to load more cargo is the largest contribution to the pay-back of the investment. There is also a saving in maintenance but the value of this has not yet been quantified."

DNV GL believes that recent progress at a regulatory level is helping to boost confidence among shipowners that composite materials can be a safe and economic solution. "The interest among shipowners but also well-known shipyards is increasing in our opinion. Recent advances at the IMO level on new guidelines for composite components (MSC.1/Circ.1574 on Interim guidelines for use of Fibre Reinforced Plastic (FRP) elements within ship structures: Fire safety issues) and the popularity of the ELASS network (the European network for lightweight applications at sea: http://e-lass.eu) are just two examples."

> "Most components in shipbuilding are manufactured outside the yard and there are plenty of composite manufacturers in the world"

The design features eight cargo holds and four deck cranes



Batteries, engines and fuel

The overall efficiency savings must, of course, be viewed in the context of the vessel concept's other innovations. Another is the use of an optimal-size battery pack, which partially substitutes for the auxiliary engines and compensates for fluctuations in power demand. A DNV GL feasibility study concluded that the battery pack could allow for a 20% saving in crane operation fuel costs, with an estimated payback of six to nine years, while cutting engine running hours by 50%. Overall, the vessel is 55% below the EEDI reference line for cargo ships.

A study of comparable open-hatched cargo vessels with typical load profiles indicated fuel savings of up to 10% in operating an optimised main engine with a PTO/PTI shaft generator, in addition to a significant drop in maintenance costs. Consequently, the base design is equipped with a 6-cylinder, 2 stroke MAN Tier III engine configured to run on low-sulphur fuel oil (LSFO). There is also the low-sulphur Super Eco Fuel, a mixture of light cycle oil (LCO), gas-to-liquid (GTL) and water which can be run without the use of EGR or SCR systems that Oshima has developed in partnership with the industry. Alternatively, owners will have the option of an engine operating on HFO and scrubbers.

Oshima Shipbuilding is confident that while the dry sector has experienced a lean few years, there remains a high level of interest and trading scope for mixed cargo carriers, or indeed converting older vessels to serve that market. "The predictions of demands for new-buildings are readily available from companies specialising in market studies," says the shipbuilder. "However, composite tween decks are available for retrofit on existing open-hatch bulk carriers. Hence, the market for composite tween decks is not limited to the new-building market." ***NA***